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Hub, notably for bicycles and such like

Description

The present invention relates to a hub which is especially suitable for bicycles. However, this is not the only possible use; hubs of this kind may also be employed, for example, in wheelchairs, (bicycle) trailers, and other muscle-driven or non-muscle-driven vehicles and contrivances. For purposes of simplification, however, the invention will be described in the following with reference to its use with bicycles, whereby said description shall not be understood in any way as a limitation of use.

Hubs serve for connecting the bicycle frame with the wheel. Usually, a hub comprises a stationary axle and a hub shell mounted rotatably thereto, on which spokes may be arranged in order to connect the hub shell with the rim of the wheel. Although nowadays, in addition to said spokes, connections are increasingly being utilized which employ only three or four plastic supports for the connection with the rim, or which employ disks such as carbon disks.

The demands placed on such hubs are very high especially in the field of high performance sports, but not limited solely thereto.

On the one hand, a bicycle hub must reliably take up intense forces which, for example, are introduced into mountain bikes during off-road rides; on the other hand, a hub should feature a weight as low as possible when used, for example, on so-called racing bikes, in order to enable attaining a speed as high as possible.

Furthermore, a hub must also function reliably, even over prolonged periods of time.

It is customary in the fields of professional and semi-professional cycling to service such hubs prior to every or almost every use. Therefore, it is also necessary that the hub be easily dismantled and reassembled.

During the last few years, it has become increasingly popular to undertake extended bicycle tours or also to explore remote countries with bicycle and luggage. Due to long rides over uneven terrain or terrain having no distinct path, but also due to normal wear and tear, parts of a hub may show damage, deteriorate or wear out.

In this case, it then becomes necessary to repair the hub and to replace the worn elements. Hence, it is further necessitated that spare parts for such hubs are readily and quickly available.

It is therefore the task of the present invention to provide a hub for a bicycle which fulfills the afore-mentioned requirements and which provides reliable operation while also featuring simple disassembly and low weight at the same time.

This task is solved in accordance with the present invention by the objects of claim 1, claim 2, claim 17 and claim 18.

Preferred embodiments of the invention constitute the subject matter of the subclaims.

The present invention provides a bicycle hub having low weight and high operational reliability and durability and which is easy to maintain.

The hub according to the present invention comprises a hub axle and a hollow hub shell arranged concentrically thereto, which is rotatably mounted relative to said hub axle by means of at least two roller bearings which are preferably of commensurate configuration or identical, respectively. At least two of said roller bearings are arranged adjacent to one another. Said at least two adjacently

arranged roller bearings are disposed side by side to one another at an essentially narrow spacing.

A narrow spacing in the sense of the present application means that the axial distance between the adjacently disposed roller bearings is smaller than the axial width of one of said two roller bearings. Preferably, the axial distance between the two roller bearings is smaller than half the axial width of one of said bearings and, especially preferred, said distance is smaller than one-tenth of the axial width of one of said roller bearings. Particularly preferred, the two roller bearings are arranged so as to essentially abut up against one another.

In the sense of the present application, arranged essentially abutting up against each other means that, preferably, both bearings abut up against one another, respectively that a reciprocal contact of the bearings is not prevented by any additional measures.

The roller bearings employed for bearing comprise roller bodies; and the roller bodies of each roller bearing are arranged at a predetermined distance to one another. Preferably, commercial roller bearings are used.

In a further embodiment of the hub according to the present invention, the hub comprises a hollow hub axle and a hub shell rotatably mounted relative thereto by means of roller bearings. In each case, the roller bearings comprise roller bodies which are each disposed at a predetermined distance to one another, such as in the preceding inventive hub embodiment. Furthermore, a hub of this type is provided with a first diameter section intended to be inserted into a bicycle frame drop-out.

The hub, hub axle respectively, is moreover disposed with at least a second diameter section which is arranged essentially in the central section of the hub axle, and which comprises an inner diameter and an outer diameter, the inner diameter of said second diameter section being equal or larger than the outer diameter of said first diameter section.

In another embodiment of the hub according to the present invention, the hub comprises a hollow hub axle which, in contrast to conventional hub axles, is configured such that the outer to inner diameter ratio is small, respectively that its wall thickness is relatively thin. This embodiment as well utilizes roller bearings for bearing the hub shell relative the hub axle, said roller bearings comprising roller bodies which are also arranged at a predetermined distance to one another. The wall thickness of the hollow hub axle at a central section in the middle of the hub is between 0.5 mm and 3 mm, preferably between 1 mm and 2.5 mm, and especially preferred between 1.7 mm and 2.3 mm; preferably at about 2 mm.

The hub according to the present invention has numerous advantages.

By utilizing roller bearings comprising a plurality of roller bodies which in each case are arranged at a predetermined distance to each other, industrially fabricated, respectively commercial, roller bearings may be used, thereby providing the inventive hub with a high degree of achieved reliability and durability.

Specifically with the use of commercial, industrially fabricated roller bearings, the replacement of worn or defective roller bearings is very simple, since with the use of bearings standardized for example according to DIN or ISO or similar norms, such bearings are available throughout the entire world within a short period of time. Thus, a replacement of a roller bearing may take place within the fastest time frame possible, even if there is no nearby bicycle shop or a bicycle dealer does not have the right bearing in stock.

The bearing of the hub shell relative the hub axle by means of two adjacent, preferably directly adjacent roller bearings, most preferably arranged as roller bearings abutting up against one another, is especially advantageous since the load that has to be received by each bearing is smaller and, therefore, roller bearings having smaller outer dimensions may be used which feature a smaller amount of space required. By using two roller bearings, instead of just one as has been the customary practice up until now, it is possible to reduce the structural and material volume while maintaining the same degree of durability and load capacity.

A hub having a hollow hub axle in which an outer diameter of the hub in a first section intended for being inserted into a bicycle frame drop-out is larger than an inner diameter section in a second diameter section which is essentially disposed in the central section of the hub axle, has numerous advantages.

Contrary to conventional hollow hub axles, a hollow hub axle according to the present invention comprises an especially large inner diameter which allows the entire hub axle to be configured particularly thin, respectively thin-walled.

In the further and other embodiments with reference to a hollow hub axle, roller bearings having roller bodies are likewise employed, whereby the roller bodies of each roller bearing are aligned at a predetermined distance to each other.

Rigidity and stability of a hub axle depend not only on its mass or volume, respectively the material used, but also on its distributed geometric arrangement. The flexural strength of hubs increases with increasing diameter. Sections lying radially further outside contribute to the flexural strength in an overly proportional manner. Therefore, a hub according to the present invention is especially advantageous, since due to its large outer diameter combined with its thin wall thickness, high flexural strength is achieved with reduced material use and, hence, at reduced weight.

It must be noted that a further preferred embodiment of all the configurations previously described above may also make use of the characteristics of a single or of all of the configurations as thus far described.

In a further preferred embodiment of the inventive hub according to one or several of the configurations as described above, the hub further comprises a rotator on which at least one, preferably up to 10 or more gears are arranged, and which is rotatably mounted relative to the hub axle by means of at least one roller bearing, and which comprises a freewheel device disposed between said rotator and said hub shell.

This embodiment is especially used for rear wheels of bicycles since these are the wheels which are usually driven. In the state of the art, however, bicycles have also become known in which it is the front wheel which is driven and, of course, this embodiment of an inventive hub according is also suitable for such front wheels.

The use of such a hub according to the present invention as a drive hub, rear wheel hub respectively, has numerous advantages, since due to the use of two adjacently arranged roller bearings, instead of just one roller bearing such as is known in the state of the art, the material use or the structural volume of the rear wheel hub may be reduced and, hence, weight is saved.

Utilizing a hollow hub axle according to the present invention also allows for saving weight as compared to conventional hubs.

In a further preferred embodiment of all configurations as previously described above, the roller bearings comprise bearing cages in which the roller bodies of the respective roller bearings are retained or arranged at predetermined distances. Said bearing cages are preferably made from plastic or metal.

In a further preferred embodiment, the roller bearings additionally comprise an inner, or respectively outer, ring; an inner ring and an outer ring is especially preferred.

The use of roller bearings having an inner and an outer ring is particularly advantageous since upon wear or deterioration of one or several roller bodies, the entire roller bearing can be easily replaced.

With conventional bicycle hubs, a cone-shaped section on the hub axle often serves as the inner race surface for the roller bodies, whereas the outer race surface is formed in the hub shell. Due to normal wear and tear, exceeding of the operating life, or because of penetration of foreign particles or dust, the roller bodies may thus become destroyed; scoring and other damage occurs to the inner

and/or outer race surfaces of the hub axle and the hub shell in conventional hubs of this type, which may in turn result in the entire hub becoming unusable. Such damage is avoided when utilizing roller bearings having an inner and an outer ring.

In a preferred embodiment of the bicycle hub according to the present invention, grooved ball bearings, needle bearings respectively, are used as roller bearings; whereby the bearings employed preferably comprise seals against dust or water and are, especially preferred, maintenance-free.

An embodiment of this type is especially advantageous since it is particularly with the use of sealed and maintenance-free bearings that the reliability and operational readiness of a hub according to the present invention becomes especially high and the operating lifetime of the bearings increase.

According to the embodiment of the inventive hub as described initially, upon employing two adjacently arranged roller bearings for bearing the hub shell relative the hub axle, it is then especially preferred that commensurate, especially structurally identical grooved ball bearings are used, whereas needle bearings may also be used for supporting the rotator relative the hub shell especially in rear wheel hubs. In this case, said needle bearings preferably comprise only one inner or outer ring or only one needle ring so as to keep the overall structural height in radial direction and, hence, the total weight, as low as possible.

As far as further possible embodiments are concerned, and especially with respect to bearing configuration, reference is made to the parallel application of the same applicant (attorney's file No. 4571P197), filed with the German Patent Office on the same day as the present application, and which describes a freewheel hub; the description, figures and entire contents of which are herewith integrated within the disclosure of the present application.

In a further preferred embodiment of the hub according to the present invention, at least one of the roller bearings and especially one of the roller bearings for supporting the hub shell and/or the rotator is mounted as a floating bearing and

especially as an axially floating bearing. The fitting accuracy of said floating bearing is between 0.02 mm and 0.5 mm, preferably between 0.05 mm and 0.15 mm; particularly preferred is at about 0.1 mm. Especially preferred, the two outer roller bearings for bearing the hub shell are floating mounted bearings, particularly, but not limited to, when two adjacent roller bearings, grooved ball bearings respectively, are used for providing support in each case.

Yet it is also possible that a bearing is mounted as an axially floating bearing on only one side. In rear wheel hubs, this is preferably the side of the hub which is not driven.

When no bearings are mounted as floating bearings, a (slight) distortion which is maintained in the mounted state, may occur during the press-fitting of the bearings to the hub shell, the rotator or hub axle, respectively. Especially with rear wheel hubs, a distortion of the individual bearings may result in the rotator exhibiting a slight angular offset which may lead to chain displacement. Therefore, the bearings of the inventive hub which are situated most distal the hub center are preferably mounted as floating bearings.

Preferably, the hub axle is essentially of cylindrical shape, and its outer surface may comprise two ring-shaped or half-conical-shaped bosses which each have a stop on their side orientated facing away from the hub center. Said latter stops serve for the axially fixing of roller bearings on the left and right side of the hub relative the hub axle.

The further embodiment of a hub according to the present invention includes characteristics such as described in the same applicant's application No. DE 197 31 451.1, filed with the German Patent Office on July 22, 1997 or No. DE 198 47 673.6, filed with the German Patent Office on October 15, 1998. The contents of said applications are therefore integrated into the disclosure of the present application.

Preferably, a hub according to the present invention comprises sealing means in order to prevent dust or water and other pollutants from penetrating into the interior of the hub shell.

With an embodiment as a rear wheel hub, preferably at least one further sealing means is disposed between the rotator and the hub axle and one between the rotator and the hub shell. The special configuration of this sealing means is preferably realized such as described in the above-mentioned DE 197 31 451.1 or DE 198 47 673.6, or as described in the same applicant's application filed with the German Patent Office on the same day as the present application (attorney's file No. 4571P197).

Preferably, an elastomer seal is arranged downstream a labyrinth seal on at least one of said sealing means.

An embodiment of such a type of sealing means is especially advantageous since especially when arranging two, particularly different sealing elements in series, an exceptionally high sealing effect is achieved.

In a further preferred embodiment of the hub according to the present invention, the hub may essentially be disassembled manually without the use of tools. Furthermore, the rotator may likewise essentially be manually removed, detached respectively, without the need for tools.

A configuration of this type is especially advantageous since frequent cleaning and maintaining of the hub is necessary, particularly in the field of high performance sports. The hub according to the present invention is easily dismantled and it is preferably so configured that no essential parts such as ratchet pawls, when a ratchet freewheel is used, or balls from ball bearings and the like, will fall out of the hub even during dismantling.

On at least one, preferably on both ends of the hub axle, a right or left adapter ring is respectively arranged which may be screwed onto the hub axle or slipped onto the hub in order to allow particularly easy dismantling.

Employing the hub according to the present invention as a drive hub, rear wheel hub respectively, the freewheel device may comprise two gear rings arranged essentially concentrically to the hub axle, whereby said gear rings in each case have a toothed surface.

The toothed surfaces of said two gear rings are pressed together by means of a pre-tensioning device, and at least one gear ring or both gear rings remain a floating gear ring, so that a tilting of at least one gear ring relative to a plane which runs perpendicular to a center line of the hub axle is possible.

A freewheel device of this kind has already been described in the above-mentioned applications Nos. DE 198 47 673.6, respectively DE 197 31 451.1 of the same applicant. Therefore, a detailed description thereof will be refrained from here.

In a further preferred embodiment of the inventive hub for rear wheels, the freewheel device comprises at least one, preferably two, three or four ratchet pawls which are preferably arranged symmetrically along the periphery of a ratchet carrier device, and which engage preferably into depressions, grooves or meshing on the inner peripheral surface of the rotator for the rotator torque transmission to the hub shell.

Preferably, the hub shell and/or the hub axle is made of metal, especially preferred from a light metal or a light metal alloy such as aluminum. The rotator is likewise made from metal, and, preferably, from an aluminum alloy or, for cases of particularly high stress loads, from steel.

Further advantages, characteristics and possible applications of the present invention will now be described with respect to an embodiment and in reference to the drawings, which show:

Fig. 1 a sectional view of an embodiment of the hub for a front wheel according to the present invention; and

Fig. 2 a sectional view through the hub axle of the embodiment according to Fig. 1; and

Fig. 3 a sectional view of a further embodiment of the hub for a rear wheel according to the present invention; and

Fig. 4 a sectional view through the hub axle of the embodiment according to Fig. 3.

A first embodiment of the inventive hub 3a especially designed for a front wheel will now be described with reference to Figs. 1 and 2. Hub 3a comprises a hub axle 4a and a hub shell 1a.

On the left side of hub 3a (according to the alignment of Fig. 1), two structurally identical grooved ball bearings 2 are disposed directly adjacent to one another for the rotatable bearing of the hub shell relative hub axle 3a.

The ball bearing 2 arranged more inwardly of the hub center is secured to the right by means of stop 36 in a left end section of hub shell 1a, and by means of stop 35 on the hub axle in the area of nub 37 having a larger diameter.

The ball bearing 2 disposed left of said ball bearing 2 above is an axially floating mounted bearing with a fitting accuracy of about 0.1 mm. Ball bearings 2 are designed to be maintenance-free and comprise seals against dust and water. They are commercial and standardized bearings of high or highest quality, often also designated as industrial bearings, since they are industrially fabricated for a vastly diverse number of bearing purposes.

Left of ball bearings 2, meaning away from the hub center, a left adapter ring 13 is slid upon the end of hub axle 4a, said ring being designed essentially rotationally symmetrical. Said adapter ring externally terminates the hub shell on this side of the hub. An annular seal having a V-shaped cross section is disposed on the outer

surface of the adapter ring in a cylindrically shaped end section situated on its side facing the hub center. The opening of the V between the two seal walls faces essentially radially outwardly.

V-shaped seal 18 is arranged between the left adapter ring 13 and a left end section of hub shell 1a. The seal wall of seal 18 which is disposed on the side facing towards the hub center, is in sliding contact with a peripheral groove in the left end section of hub shell 1a, so that dust or water penetrating from outside may not reach the bearing section of ball bearing 2.

The radial direction of the second seal wall of seal 18 ends shortly before hub shell 1a, so that a small, axially extending slot remains in radial direction between the first seal wall of seal 18 and hub shell 1a in the left end section and forms a kind of upstream labyrinth seal.

A peripheral groove is provided on an inner circumferential surface of adapter ring 13 in the right end section for receiving an O-ring 16 made of flexible material. Said O-ring 16 seals the hub axle 4a relative the left adapter ring 13 and additionally secures the left adapter ring 13 against axial displacement.

Both sides of hub 3a according to the present invention are configured essentially symmetrical. On the right-hand side, a right adapter ring 12 is arranged which is structurally identical to the left adapter ring 13. In the same way, two identical ball bearings 2 are disposed in a right-hand section of hub axle 4a for rotatably bearing the hub shell relative hub axle 4a.

The inner ring with the inner race surface of ball bearing 2 which is aligned towards the hub center and which is on the right-hand side of hub 4a, is axially supported by means of stop 35 in a section of an axial boss of hub axle 4a, while the outer ring with the outer race surface for said ball bearing is axially supported towards the hub center by means of stop 36 in hub shell 1a.

The inner diameter 41 of hub axle 4a according to the present invention is about 12 mm and is larger than an outer diameter 38 of the left, respectively right, adapter ring 12, 13 in an end section of the respective adapter ring: said adapter rings being provided to be inserted into a bicycle frame drop-out in order to keep the hub in the frame or the fork, respectively.

Fig. 2 shows a sectional view through the inventive hub axle 4a of the embodiment according to Fig. 1. Hub axle 4a is configured essentially cylindrical and comprises a section, respectively a collar 37 having a larger diameter positioned near the right, respectively left end section which has abruptly dropping stops 35 on the side facing away from the hub center.

The inner diameter 41 of the hub axle according to the present invention is 12 mm, whereby the diameter may be a minimum of at least 11.8 mm, but however no more than a maximum of 12 mm. An outer diameter 42 is 15 mm, whereby the tolerance in the end sections where the ball bearings are arranged is less than 15 µm. The maximum diameter 43 of hub axle 4a is 17.5 mm for a front wheel hub and 18.5 mm for a rear wheel hub.

The rear wheel hub 4b according to the present invention will now be described with reference to Figs. 3 and 4.

The hub 3b comprises a hub axle 4b, a hub shell 1b, a freewheel device 6, 8 and a rotator 5.

A right adapter ring 12 with a knurled disk 17 press-fitted or disposed thereupon, terminates the hub 3b on the right side, while a left adapter ring 13 is disposed on the left side. As has already been described for the inventive hub 3a with reference to Figs. 1 and 2, adapter rings 12, 13 each comprise a seal 18 and an O-ring 16.

The hub shell 1b is rotatably mounted relative to hub axle 4b by means of a grooved ball bearing 2 disposed in a left end section of the hub, and by means of two grooved ball bearings 30 disposed in a right end section of hub shell 1b.

The freewheel device comprises two gear rings 6 arranged concentrically to the hub axle 4b, said gear rings being pressed to each other by means of springs 8. Said springs 8 simultaneously serve for providing a floating support of gear rings 6, thus allowing them to tilt relative to a plane perpendicular to the axial center line of the hub axle.

Yet it is also possible that only one of said gear rings is a floatingly mounted gear ring. A detailed description of the configuration and the functional characteristics of such a freewheel device having one or two floatingly mounted gear rings has been provided in the above-mentioned German patent applications No. DE 198 47 673.6 and DE 197 31 451.1, to which reference is made here. In particular, for the detailed configuration of the freewheel device, reference is made to the description of Figs. 1, 4a, 4b, 5a, 5b, 5c of German patent application DE 198 47 673.6 and of which same may therefore be refrained from here.

The gear ring 6 arranged towards the hub center is ringed by a threading 7 screwed into hub shell 1b which is preferably made from hardened steel.

The rotator is rotatably mounted with respect to the hub axle by means of two grooved ball bearings 2, whereby a spacer tube 11 is arranged between said grooved ball bearings 2. The inner peripheral surface of the rotator comprises a groove in a central section in which a lock ring 10 is disposed.

A cover disk 14 is disposed between the right adapter ring 12 and the rotator.

A seal 9 is disposed between rotator 5 and hub shell 1b at the end section of rotator 5 orientated towards the hub center in order to prevent water and dust from penetrating into the interior of said hub.

The inner diameter 51 of the inventive hub axle 4a is about 12 mm and is larger than an outer diameter 38 of the left, respectively the right, adapter ring 12, 13.

Fig. 4 shows a sectional view through the hub axle 4b. Hub axle 4b is essentially cylindrical in shape and comprises two sections, respectively collars 37, having a larger diameter,.

The inner diameter 51 of hub axle 4b corresponds to the inner diameter 41 of hub axle 4a, and the outer diameter 52 of hub axle 4b corresponds to the outer diameter 42 of hub axle 4a. The wall thickness 54 is 3 mm, identical to the wall thickness 44 of hub axle 4a.

List of reference numerals

1a	hub shell	16	O-ring
1b	hub shell	17	knurled disk
2	grooved ball bearing	18	seal
3a	hub	19	fitting disk
3b	hub	30	grooved ball bearing
4a	hub axle	35	stop
4b	hub axle	36	stop
5	rotator	37	nub *(Wulst)*
6	gear ring	37	collar *(Ring)*
7	threading	38	diameter
8	spring	41	diameter
9	seal	42	diameter
10	lock ring	43	diameter
11	spacer tube	44	wall thickness
12	adapter ring	51	diameter
13	adapter ring	52	diameter
14	cover disk	54	wall thickness